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Structural Design Analysis of a 500kW Wind Turbine

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Abstract: This report presents briefly the structural design analysis of a 500kW two-bladed downwind type wind turbine indigenous developed under NMITLI program. The major components developed were rotor blades, teetered hub, rotor shaft, platform and yaw system whereas gear box and alternator were procured. Several configurations were initially explored for each subsystem and finally the suitable one for a prototype was fabricated. The wind turbine developed composed of minimum elementary systems required for prototype testing. The design has been rationalized/ simplified for single set/piece fabrication. The aerodynamic design of the blade was carried out in a separate exercise and the aerodynamic loads obtained were used for this structural analysis. Further, a special purpose code, "BLADED' was used to generate aerodynamic loads for some cases. The critical loads in all phases of wind turbine existence were identified and used in the design. The blade apart from generating power is the source from where all the dynamic loads originates. The blade shell was made out of glass-epoxy laminates. The load carrying spar integrated with the shell of the blade composed of more UD layers. Foam sandwich construction was employed in non-critical area. The blade was attached to the hub flange with use of T-Bolts embedded into the root. Preload was introduced into the T-Bolt to improve it's the fatigue life. Shaft and teeter pin were made out of forged EN24 steel whereas hub, platform and yaw system were fabricated out of plates by welding. Thus, the design exercise was focused for the prototype wind turbine development.